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allowable offset in any precast concrete facing panel joint shall be 3/4 inch. The maximum allowable offset in any concrete block joint shall be 3/8 inch.

4. The base of the structural earth wall excavation shall be within three inches of the staked elevations, unless otherwise approved by the Engineer.
5. The external structural earth wall dimensions shall be placed within two inches of that staked on the ground.
6. The backfill reinforcement layers shall be located horizontally and vertically within one inch of the locations shown in the structural earth wall working drawings as approved by the Engineer.

At least five working days prior to the Contractor beginning any structural earth wall work at the site, a structural earth wall preconstruction conference shall be held to discuss construction procedures, personnel, and equipment to be used, and other elements of structural earth wall construction. Those attending shall include:

1. (representing the Contractor) The superintendent, on site supervisors, and all foremen in charge of excavation, leveling pad placement, concrete block and soil reinforcement placement, and structural earth wall backfill placement and compaction.
2. (representing the Structural Earth Wall Manufacturer) The qualified and experienced representative of the structural earth wall manufacturer as specified at the beginning of this Section.
3. (representing the Contracting Agency) The Project Engineer, key inspection personnel, and representatives from the WSDOT Construction Office and Materials Laboratory Geotechnical Services Branch.

6-13.3(2) Submittals

The Contractor, or the supplier as the Contractor's agent, shall furnish to the Engineer a Manufacturer's Certificate of Compliance in accordance with Section 1-06.3, certifying that the structural earth wall materials conform to the specified material requirements. This includes providing a Manufacturer's Certificate of Compliance for all concrete admixtures, cement, fly ash, steel reinforcing bars, reinforcing strips, reinforcing mesh, tie strips, fasteners, welded wire mats, backing mats, construction geotextile for wall facing, drainage geosynthetic fabric, block connectors, and joint materials. The Manufacturer's Certificate of Compliance for geogrid reinforcement shall include the information specified in Section 9-33.4(4) for each geogrid roll, and shall specify the geogrid polymer types for each geogrid roll.

A copy of all test results, performed by the Contractor or the Contractor's supplier, which are necessary to assure compliance with the specifications, shall be submitted to the Engineer along with each Manufacturer's Certificate of Compliance.

Before fabrication, the Contractor shall submit a field construction manual for the structural earth walls, prepared by the wall manufacturer, to the Engineer for approval in accordance with Section 6-01.9. This manual shall provide step-by-step directions for construction of the wall system.

1 The Contractor, or the supplier as the Contractor's agent, shall submit detailed design
2 calculations and working drawings to the Engineer for approval in accordance with Section
3 6-01.9.

4
5 The design calculation and working drawing submittal shall include detailed design
6 calculations and all details, dimensions, quantities, and cross-sections necessary to
7 construct the wall. The calculations shall include a detailed explanation of any symbols and
8 computer programs used in the design of the walls. All computer output submitted shall be
9 accompanied by supporting hand calculations detailing the calculation process.

10
11 The design calculations shall be based on the current AASHTO Standard Specifications for
12 Highway Bridges including current interims, and also based on the following:

- 13
14 1. The factor of safety for overturning and sliding are 2.0 and 1.5 respectively for
15 AASHTO Load Group I, and 1.5 and 1.1 respectively for AASHTO Load Group VII.
- 16
17 2. The wall surcharge conditions (backfill slope) shown in the Plans.
- 18
19 3. If a highway is adjacent to and on top of the wall, a two foot surcharge shall be
20 used in the design.
- 21
22 4. If the Plans detail a traffic barrier on top of the wall, the barrier and wall shall be
23 capable of resisting a 10,000 pound horizontal load applied at the top of the barrier.
- 24
25 5. The geotechnical design parameters for the wall shall be as specified in the Special
26 Provisions.

27
28 A minimum of six sets of working drawings shall be fully detailed and shall include, but not
29 be limited to, the following items:

- 30
31 1. A plan and elevation sheet or sheets for each wall, containing the following:
32
33 a. An elevation view of the wall which shall include the following:
34
35 i. the elevation at the top of the wall, at all horizontal and vertical
36 break points, and at least every 50 feet along the wall;
37
38 ii. elevations at the base of welded wire mats or the top of leveling
39 pads and foundations, and the distance along the face of the wall
40 to all steps in the welded wire mats, foundations and leveling
41 pads;
42
43 iii. the designation as to the type of panel, block, or module;
44
45 iv. the length, size, and number of geogrids or mesh or strips, and
46 the distance along the face of the wall to where changes in
47 length of the geogrids or mesh or strips occur; or
48
49 v. the length, size, and wire sizes and spacings of the welded wire
50 mats and backing mats, and the distance along the face of the
51 wall to where changes in length, size, and wire sizes and
52 spacings of the welded wire mats and backing mats occur; and

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vi. the location of the original and final ground line.

- b. A plan view of the wall which shall indicate the offset from the construction centerline to the face of the wall at all changes in horizontal alignment; the limit of the widest module, geogrid, mesh, strip or welded wire mat, and the centerline of any drainage structure or drainage pipe which is behind or passes under or through the wall.
 - c. General notes, if any, required for design and construction of the wall.
 - d. All horizontal and vertical curve data affecting wall construction.
 - e. A listing of the summary of quantities provided on the elevation sheet of each wall for all items including incidental items.
 - f. Cross-section showing limits of construction. In fill sections, the cross-section shall show the limits and extent of select granular backfill material placed above original ground.
 - g. Limits and extent of reinforced soil volume.
- 2. All details including steel reinforcing bar bending details. Bar bending details shall be in accordance with Section 9-07.1.
 - 3. All details for foundations and leveling pads, including details for steps in the foundations or leveling pads, as well as allowable and actual maximum bearing pressures for AASHTO Load Groups I and VII.
 - 4. All modules and facing elements shall be detailed. The details shall show all dimensions necessary to construct the element, all steel reinforcing bars in the element, and the location of reinforcement element attachment devices embedded in the precast concrete facing panel or concrete block.
 - 5. All details for construction of the wall around drainage facilities, sign, signal, luminaire, and noise barrier wall foundations, and structural abutment and foundation elements shall be clearly shown.
 - 6. All details for connections to traffic or pedestrian barriers, coping, parapets, noise barrier walls, and attached lighting shall be shown.
 - 7. All details for the traffic or pedestrian barrier attached to the top of the wall (if shown in the Plans) including interaction with bridge approach slabs.

The Contractor shall not begin wall construction (including precast concrete facing panel fabrication) until receiving the Engineer's written approval of the material certifications and test results, design calculations and working drawing submittals.

6-13.3(3) Excavation and Foundation Preparation

Excavation shall conform to Section 2-09.3(4) and to the limits and construction stages shown in the Plans. Foundation soils found to be unsuitable shall be removed and replaced in accordance with Section 2-09.3(1)C. The foundation for the structure shall be graded

1 level for a width equal to or exceeding the length of reinforcing as shown in the structural
2 earth wall working drawings as approved by the Engineer and, for walls with geogrid
3 reinforcing, in accordance with Section 2-12.3. Prior to wall construction, the foundation, if
4 not in rock, shall be compacted as approved by the Engineer.

5
6 At the foundation level of the bottom course of precast concrete facing panels and concrete
7 blocks, an unreinforced concrete leveling pad shall be provided as shown in the Plans. The
8 leveling pad shall be cured a minimum of 12 hours and have a minimum compressive
9 strength of 1500 psi before placement of the precast concrete facing panels or concrete
10 blocks.

11 12 **6-13.3(4) Precast Concrete Facing Panel and Concrete Block Fabrication**

13 Concrete for precast concrete facing panels shall meet the following requirements:

- 14
15 1. Have a minimum 28 day compressive strength of 4,000 pounds per square inch,
16 unless otherwise specified in the Special Provisions for specific proprietary wall
17 systems.
- 18
19 2. Contain a water-reducing admixture meeting AASHTO M 194 Type A, D, F, or G.
- 20
21 3. Be air-entrained, 6 percent \pm 1 1/2 percent.
- 22
23 4. Have a maximum slump of four inches, or six inches if a Type F or G water reducer
24 is used.

25
26 Concrete for dry cast concrete blocks shall meet the following requirements:

- 27
28 1. Have a minimum 28 day compressive strength of 4,000 psi.
- 29
30 2. Conform to ASTM C 1372, except as otherwise specified.
- 31
32 3. The lot of blocks produced for use in this project shall conform to the following
33 freeze-thaw test requirements when tested in accordance with ASTM C 1262.
34 Minimum acceptable performance shall be defined as weight loss at the conclusion
35 of 150 freeze-thaw cycles not exceeding one percent of the block's initial weight for
36 a minimum of four of the five block specimens tested.
- 37
38 4. The concrete blocks shall have a maximum water absorption of one percent above
39 the water absorption content of the lot of blocks produced and successfully tested
40 for the freeze-thaw test specified in item 3 above.

41
42 Precast concrete facing panels and concrete blocks will be accepted based on successful
43 compressive strength tests and visual inspection. The precast concrete facing panels and
44 concrete blocks shall be considered acceptable regardless of curing age when compressive
45 test results indicate that the compressive strength conforms to the 28-day requirements and
46 when the visual inspection is satisfactorily completed. Testing and inspection of precast
47 concrete facing panels shall conform to Section 6-02.3(28). Testing and inspection of dry
48 cast concrete blocks shall conform to ASTM C 140.

49
50 All precast concrete facing panels shall be five feet square, except:

- 51
52 1. for partial panels at the top, bottom, and ends of the wall, and

1
2 2. as otherwise shown in the Plans.

3
4 All precast concrete facing panels shall be manufactured within the following tolerances:

- 5
6 1. All dimensions $\pm 3/16$ inch.
7
8 2. Squareness, as determined by the difference between the two diagonals, shall not
9 exceed $1/2$ inch.
10
11 3. Surface defects on smooth formed surfaces measured on a length of 5 feet shall
12 not exceed $1/8$ inch. Surface defects on textured-finished surfaces measured on a
13 length of five feet shall not exceed $5/16$ inch.
14

15 All concrete blocks shall be manufactured within the following tolerances:

- 16
17 1. Vertical dimensions shall be $\pm 1/16$ inch of the plan dimension, and the rear height
18 shall not exceed the front height.
19
20 2. The dimensions of the grooves in the top and bottom faces of the concrete blocks
21 shall be formed within the tolerances specified by the proprietary wall manufacturer,
22 for the fit required for the block connectors.
23
24 3. All other dimensions shall be $\pm 1/4$ inch of the plan dimension.
25

26 Tie attachment devices, except for geosynthetic reinforcement, shall be set in place to the
27 dimensions and tolerances shown in the Plans prior to casting.
28

29 The forms forming precast concrete facing panels, including the forms for loop pockets and
30 access pockets, and the forms forming the concrete blocks, shall be removed in accordance
31 with the recommendations of the wall manufacturer, without damaging the concrete.
32

33 The concrete surface for the precast concrete facing panel shall have the finish shown in the
34 Plans for the front face and an unformed finish for the rear face. The rear face of the precast
35 concrete facing panel shall be roughly screeded to eliminate open pockets of aggregate and
36 surface distortions in excess of $1/4$ inch.
37

38 The concrete surface for the front face of the concrete block shall be flat, and shall be a
39 conventional "split face" finish in accordance with the wall manufacturer's specifications.
40 The concrete surface of all other faces shall be Class 2 in accordance with Section 6-
41 02.3(14)B. The finish and appearance of the concrete blocks shall also conform to ASTM C
42 1372. The color of the concrete block shall be concrete gray, unless otherwise shown in the
43 Plans.
44

45 The date of manufacture, production lot number, and the piece-mark, shall be clearly marked
46 on the rear face of each precast concrete facing panel, and marked or tagged on each pallet
47 of concrete blocks.
48

49 All precast concrete facing panels and concrete blocks shall be handled, stored, and
50 shipped in accordance with Sections 6-02.3(28)G and 6-02.3(28)H to prevent chipping,
51 cracks, fractures, and excessive bending stresses.
52

Precast concrete facing panels in storage shall be supported on firm blocking located immediately adjacent to tie strips to avoid bending the tie strips.

6-13.3(5) Precast Concrete Facing Panel and Concrete Block Erection

The precast concrete facing panels shall be placed vertically. During erection, precast concrete facing panels shall be handled by means of a lifting device set into the upper edge of the panels.

Concrete blocks shall be erected in a running bond fashion in accordance with the wall manufacturer's field construction manual, and may be placed by hand. The top surface of each course of concrete blocks, including all pockets and recesses, shall be cleaned of backfill and all extraneous materials prior to connecting the reinforcing strips or geosynthetic reinforcing, and placing the next course of concrete blocks. Concrete blocks receiving geosynthetic reinforcement shall be connected as specified in the Special Provisions. Cap block top courses shall be bonded to the lower course of concrete blocks as specified below. All other concrete blocks shall be connected with block connectors or pins placed into the connector slots.

Precast concrete facing panels and concrete blocks shall be placed in successive horizontal lifts as backfill placement proceeds in the sequence shown in the structural earth wall working drawings as approved by the Engineer.

External bracing is required for the initial lift for precast concrete facing panels.

As backfill material is placed behind the precast concrete facing panels, the panels shall be maintained in vertical position by means of temporary wooden wedges placed in the joint at the junction of the two adjacent panels on the external side of the wall.

Reinforcing shall be placed normal to the face of the wall, unless otherwise shown in the Plans or directed by the Engineer. Prior to placement of the reinforcing, backfill shall be compacted.

Geosynthetic reinforcing shall be placed in accordance with Section 2-12.3 and as follows:

1. The Contractor shall stretch out the geosynthetic in the direction perpendicular to the wall face to remove all slack and wrinkles, and shall hold the geosynthetic in place with soil piles or other methods as recommended by the geosynthetic manufacturer, before placing backfill material over the geosynthetic to the specified cover.
2. The geosynthetic reinforcement shall be continuous in the direction perpendicular to the wall face from the back face of the concrete panel to the end of the geosynthetic or to the last geogrid node at the end of the specified reinforcement length. Geosynthetic splices parallel to the wall face will not be allowed.

At the completion of each course of concrete blocks and prior to installing any block connectors or geosynthetic reinforcement at this level, the Contractor shall check the blocks for level placement in all directions, and shall adjust the blocks by grinding or rear face shimming, or other method as recommended by the structural earth wall manufacturer's representative and as approved by the Engineer, to bring the blocks into a level plane.

1 For concrete block wall systems receiving a cap block top course, the cap blocks shall be
2 bonded to the lower course with mortar, or with an adhesive capable of bonding the concrete
3 block courses together.
4

5 **6-13.3(6) Welded Wire Faced Structural Earth Wall Erection**

6 The Contractor shall erect the welded wire wall reinforcement in accordance with the wall
7 manufacturer's field construction manual and as approved by the Engineer. Construction
8 geotextile for wall facing shall be placed between the backfill material within the reinforced
9 zone and the coarse granular material immediately behind the welded wire wall facing, as
10 shown in the Plans and the structural earth wall working drawings as approved by the
11 Engineer.
12

13 **6-13.3(7) Backfill**

14 Backfill placement shall closely follow erection of each course of welded wire mats and
15 backing mats, precast concrete facing panels, or concrete blocks. Backfill shall be placed in
16 such a manner as to avoid any damage or disturbance to the wall materials or misalignment
17 of the welded wire mats and backing mats, precast concrete facing panels, or concrete
18 blocks. Backfill shall be placed in a manner that segregation does not occur.
19

20 The Contractor shall place wall backfill over geosynthetic reinforcement, or construction
21 geotextile for wall facing, in accordance with Section 2-12.3 and as follows:
22

- 23 1. The Contractor shall ensure that six inches minimum of backfill shall be between
24 the geogrid reinforcement, or construction geotextile for wall facing, and any
25 construction vehicle or equipment tires or tracks at all times.
26

27 Misalignment or distortion of the precast concrete facing panels or concrete blocks due to
28 placement of backfill outside the limits of this specification shall be corrected in a manner as
29 approved by the Engineer.
30

31 The moisture content of the backfill material prior to and during compaction shall be
32 uniformly distributed throughout each layer of material. The moisture content of all backfill
33 material shall conform to Sections 2-03.3(14)C and 2-03.3(14)D.
34

35 Backfill shall be compacted in accordance with Method C of Section 2-03.3(14)C, except as
36 follows:
37

- 38 1. The maximum lift thickness after compaction shall not exceed ten inches.
39
- 40 2. The Contractor shall decrease this lift thickness, if necessary, to obtain the
41 specified density.
42
- 43 3. The Contractor shall not use sheepfoot rollers or rollers with protrusions for
44 compacting backfill reinforced with geosynthetic layers, or for compacting the first lift
45 of backfill above the construction geosynthetic for wall facing for each layer of
46 welded wire mats. Rollers shall have sufficient capacity to achieve compaction
47 without causing distortion to the face of the wall in accordance with the tolerances
48 specified in Section 6-13.3(1).
49
- 50 4. The Contractor shall compact the zone within three feet of the back of the wall
51 facing panels without causing damage to or distortion of the wall facing elements
52 (welded wire mats, backing mats, construction geotextile for wall facing, precast

concrete facing panels, and concrete blocks) by using light mechanical tampers as approved by the Engineer. No soil density tests will be taken within this area.

5. For wall systems with geosynthetic reinforcement, the minimum compacted backfill lift thickness of the first lift above each geosynthetic reinforcement layer shall be six inches.

At the end of each day's operation, the Contractor shall shape the last level of backfill to permit runoff of rainwater away from the wall face. In addition, the Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

Wall materials damaged or disturbed during backfill placement shall be either removed and replaced, or adjusted and repaired, by the Contractor as approved by the Engineer at no additional expense to the Contracting Agency.

6-13.3(8) Guardrail Placement

Where guardrail posts are required, the Contractor shall not begin installing guardrail posts until completing the structural earth wall to the top of wall elevation shown in the Plans. The Contractor shall install the posts in a manner that prevents movement of the precast concrete facing panels or concrete blocks, and prevents ripping, tearing, or pulling of the wall reinforcement.

The Contractor may cut welded wire reinforcement of welded wire faced structural earth walls to facilitate placing the guardrail posts, but only in the top two welded wire reinforcement layers and only with the approval of the Engineer in a manner that prevents bulging of the wall face and prevents ripping or pulling of the welded wire reinforcement. Holes through the welded wire reinforcement shall be the minimum size necessary for the post. The Contractor shall demonstrate to the Engineer prior to beginning guardrail post installation that the installation method will not rip, tear, or pull the wall reinforcement.

The Contractor shall place guardrail posts between the reinforcing strips, reinforcing mesh, and tie strips of the non-geosynthetic reinforced precast concrete panel or concrete block faced structural earth walls. Holes through the reinforcement of geosynthetic reinforced walls, if necessary, shall be the minimum size necessary for the guardrail post.

6-13.3(9) SEW Traffic Barrier and SEW Pedestrian Barrier

SEW traffic barrier and SEW pedestrian barrier, if shown in the Plans, shall be constructed in accordance with Sections 6-02.3(11)A and 6-10.3(2), the details in the Plans and in the structural earth wall working drawings as approved by the Engineer, except as follows:

1. The slip-form method of barrier construction will not be allowed for SEW traffic barrier and SEW pedestrian barrier.
2. The Contractor shall not begin placing backfill above the bottom of the SEW traffic barrier and SEW pedestrian barrier until removing the forms from the portion of the barrier being embedded. The Contractor shall not remove forms from the embedded portion of the barrier until the concrete has set for at least three days or has attained a minimum compressive strength of 2,400 psi.

6-13.4 Measurement

Structural earth wall will be measured by the square foot of completed wall in place. The bottom limits for vertical measurement will be the bottom of the bottom mat, for welded wire

1 faced structural earth walls, or the top of the leveling pad (or bottom of wall if no leveling pad
2 is present) for precast concrete panel or concrete block faced structural earth walls. The top
3 limit for vertical measurement will be the top of wall as shown in the Plans. The horizontal
4 limits for measurement are from the end of the wall to the end of the wall.

5
6 Backfill for structural earth wall including haul will be measured by the cubic yard in place
7 determined by the limits shown in the Plans.

8
9 SEW traffic barrier, and SEW pedestrian barrier will be measured as specified in Section 6-
10.4 for cast-in-place concrete barrier.

11 **6-13.5 Payment**

12 Payment will be made in accordance with Section 1-04.1 for each of the following bid items
13 when they are included in the proposal:

14
15
16 "Structural Earth Wall", per square foot.

17 All costs in connection with furnishing materials for, and constructing, structural earth
18 walls, including constructing leveling pads when specified, shall be included in the unit
19 contract price per square foot for "Structural Earth Wall".

20
21 "Backfill for Structural Earth Wall Incl. Haul", per cubic yard.

22 All costs in connection with furnishing and placing backfill for structural earth wall,
23 including hauling and compacting the backfill, and furnishing and placing the wall facing
24 backfill for welded wire faced structural earth walls, shall be included in the unit contract
25 price per cubic yard for "Backfill for Structural Earth Wall Incl. Haul".

26
27 "SEW Traffic Barrier", per linear foot.

28 "SEW Pedestrian Barrier", per linear foot.

29 The unit contract price per linear foot for "SEW ____ Barrier" shall be full pay for
30 constructing the barrier on top of the structural earth wall, except that when these bid
31 items are not included in the proposal, all costs in connection with performing the work
32 as specified shall be included in the unit contract price per square foot for "Structural
33 Earth Wall".